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US 4572478 A US 4111395 A

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UK CL (Edition K) F1B, F2V
INT.CL[5] F02D, F02M, F16K
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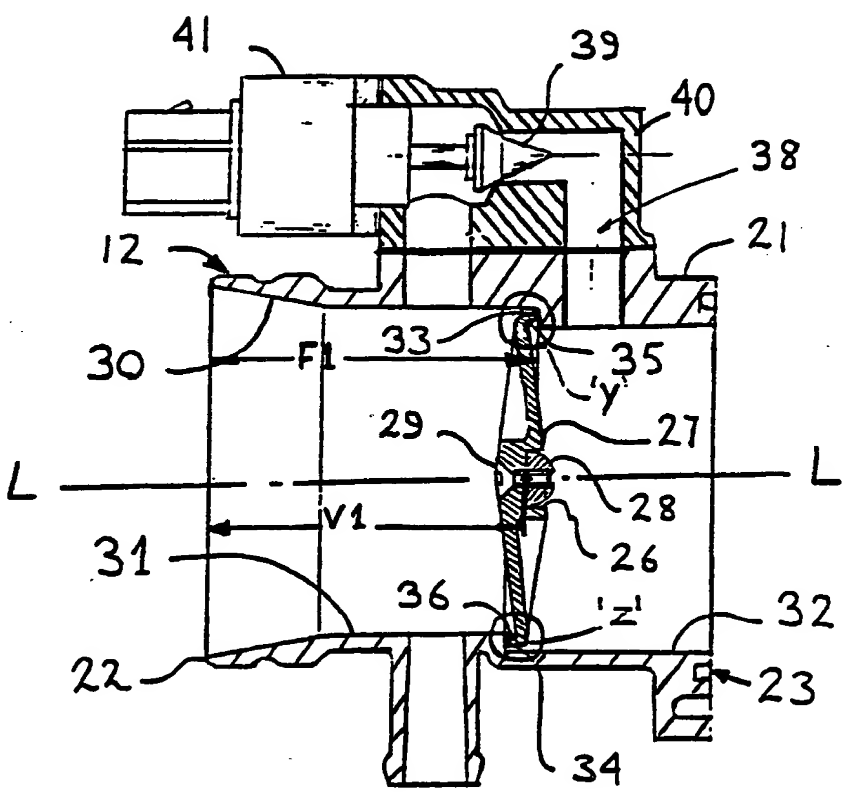
(54) I.c. engine air intake throttle body

(57) The throttle body 21 is made from a rigid plastics material and a plastics disc valve element 27 is rotatably mounted within the passage 30. A step (Fig. 8) is provided on one side or steps on both sides of the passage 30 to provide sealing surfaces 33, 34. The periphery of the element may take various forms (Figs. 6, 7 and 8) and a seal (143, Fig. 8) may be associated with the passage step. A gap (G, Figs. 8 and 9) may be provided between the valve element and one side of the passage.

Figure 4



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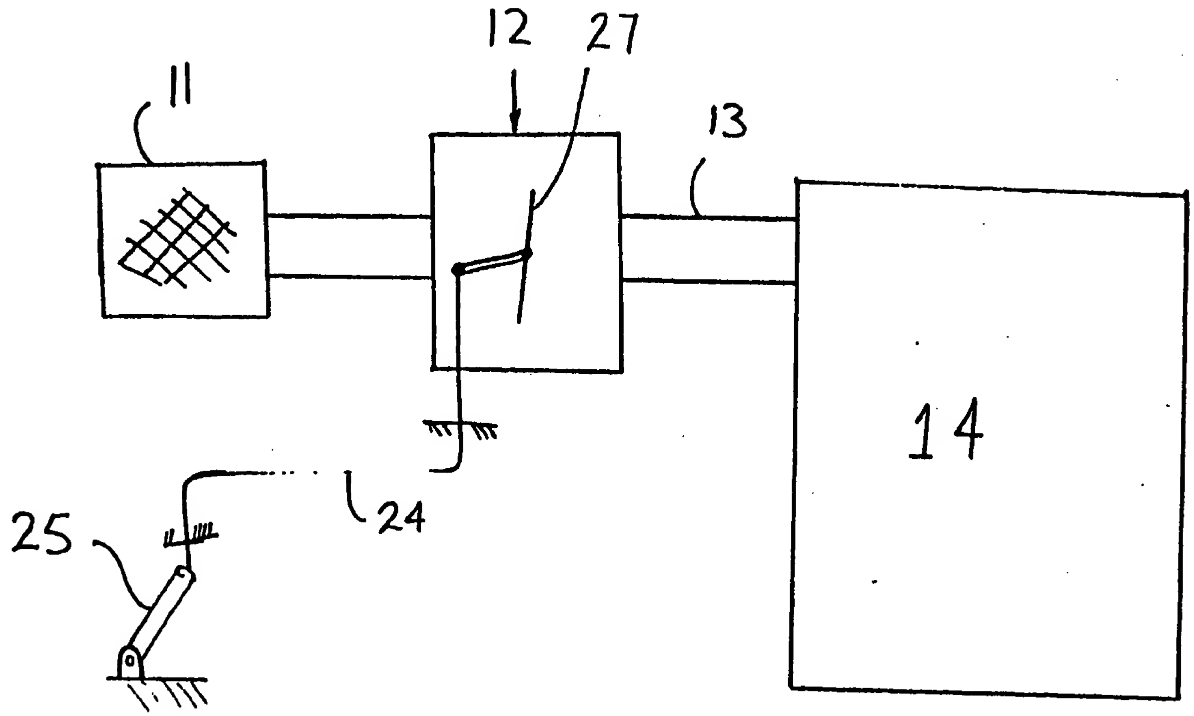


Figure 1

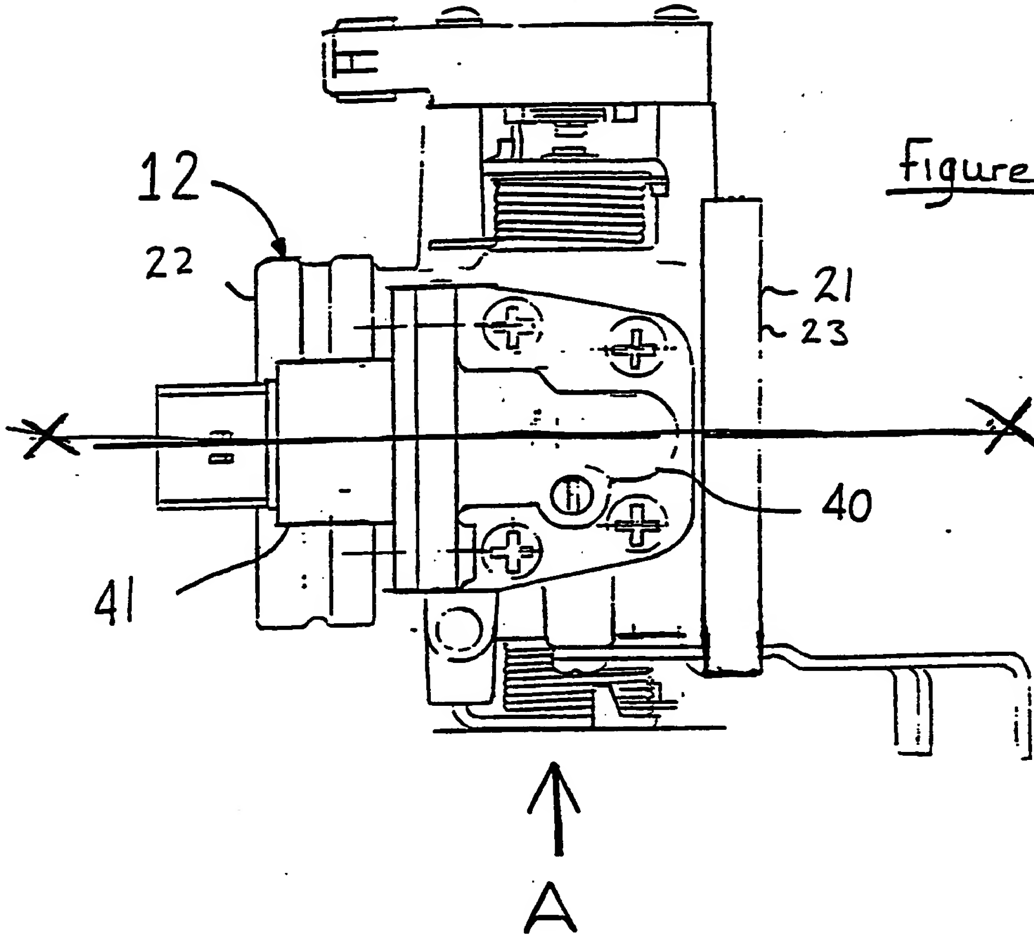


Figure 2

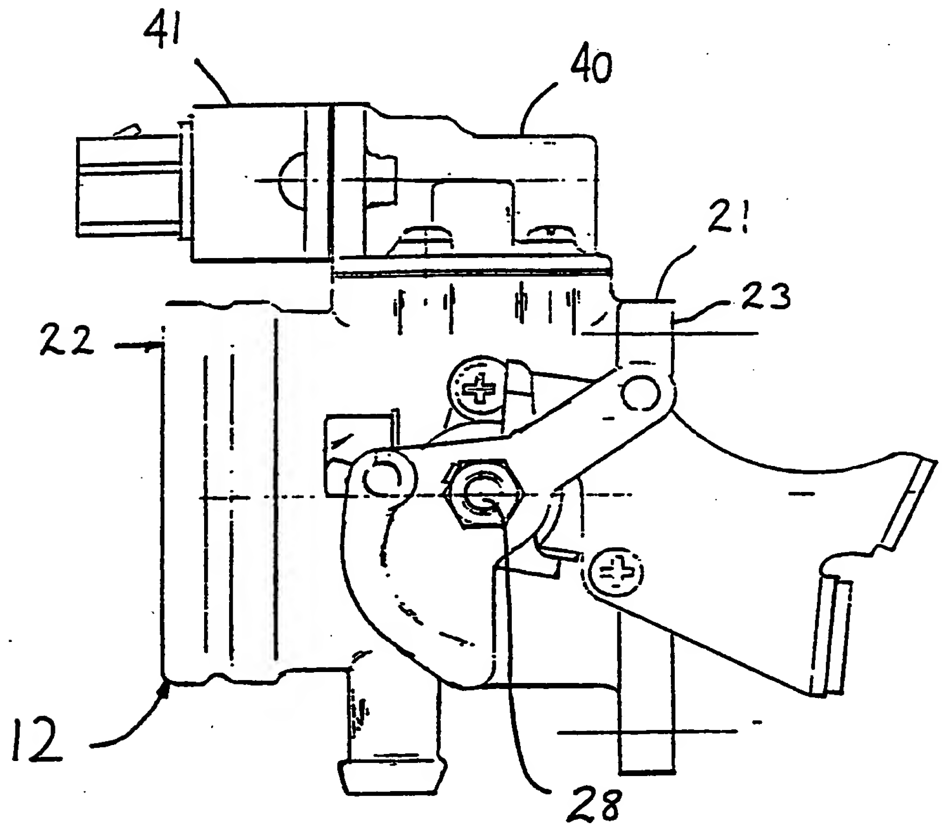


Figure 3

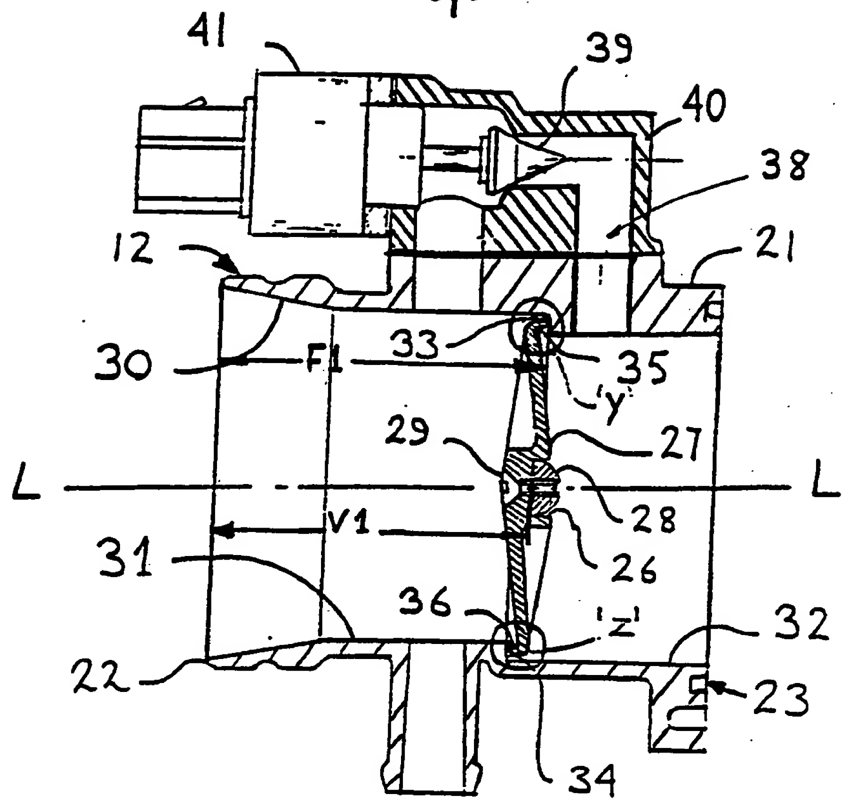


Figure 4

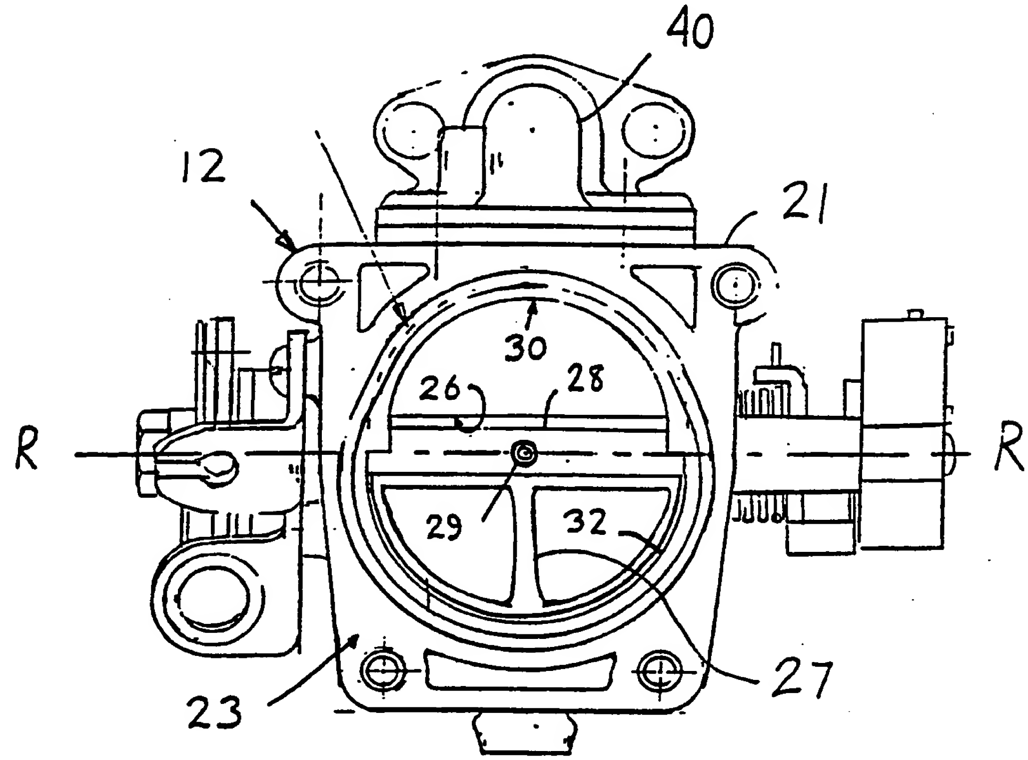


Figure 5

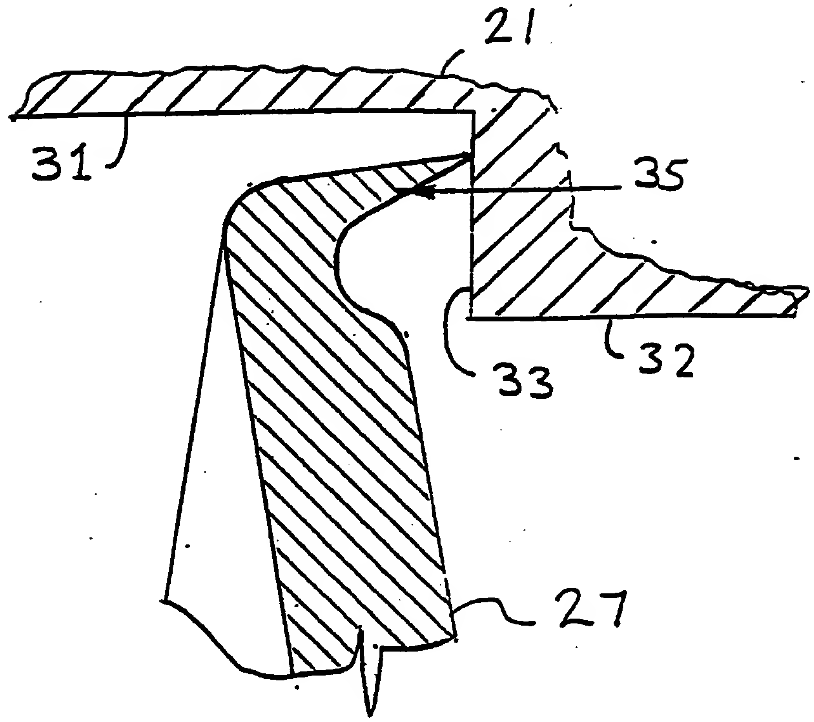


Figure 6

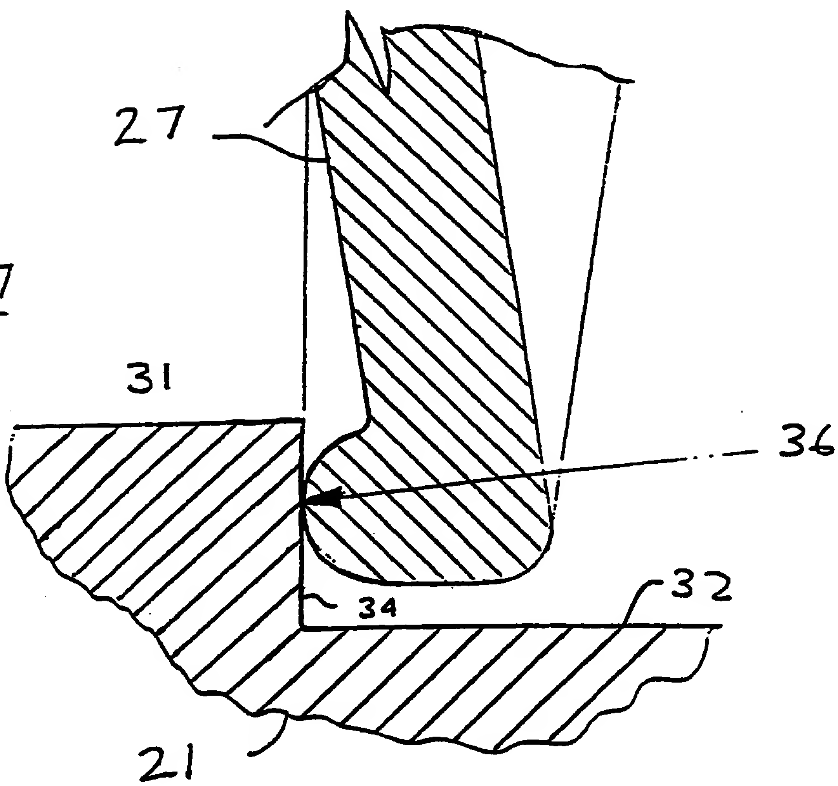
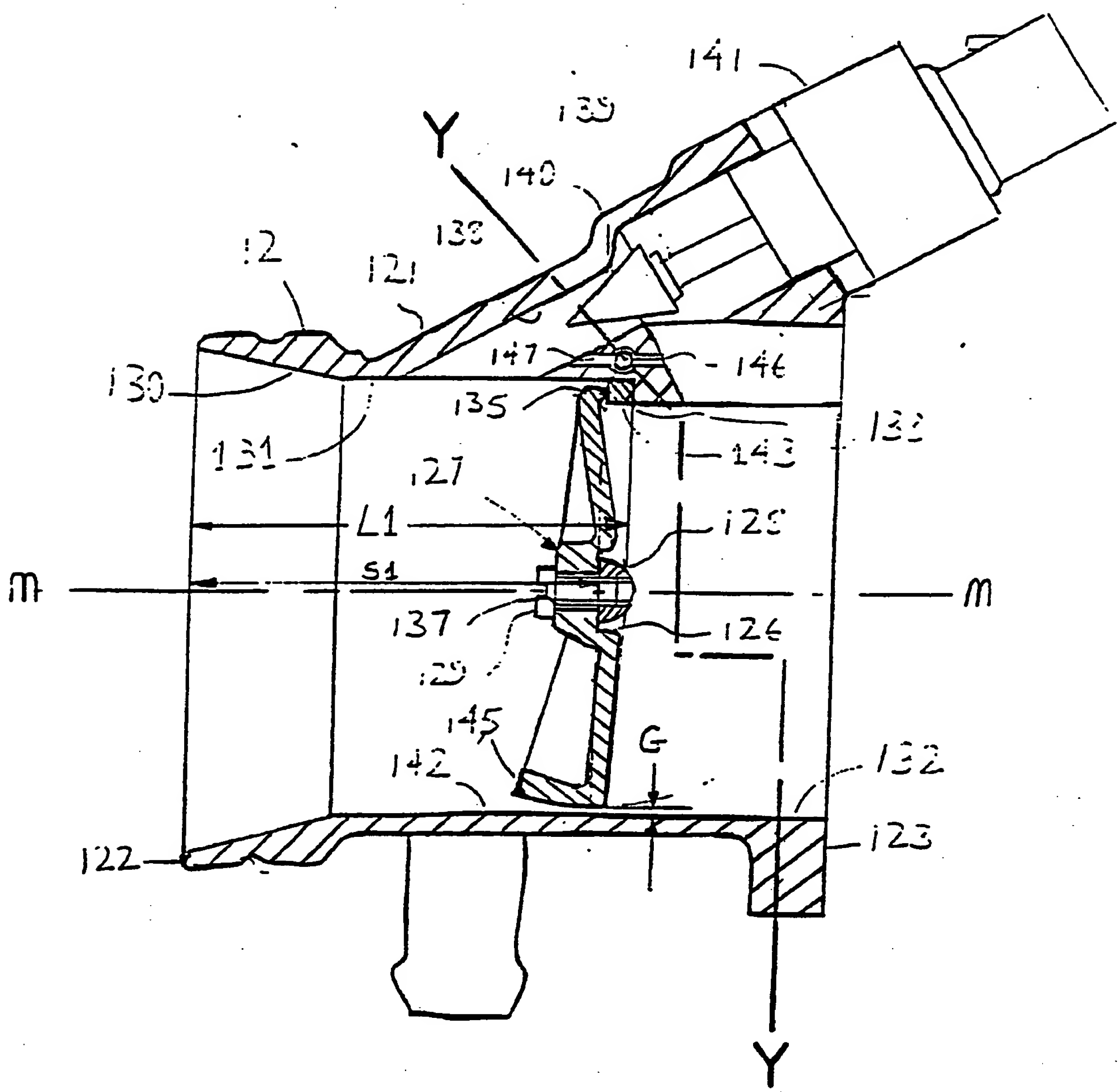


Figure 7

Figure 8


141
139
Y
140
138
12
121
147
146
130
135
143
133
131
127
L1
128
m
S1
m
137
126
129
145
G
142
132
122
123
Y

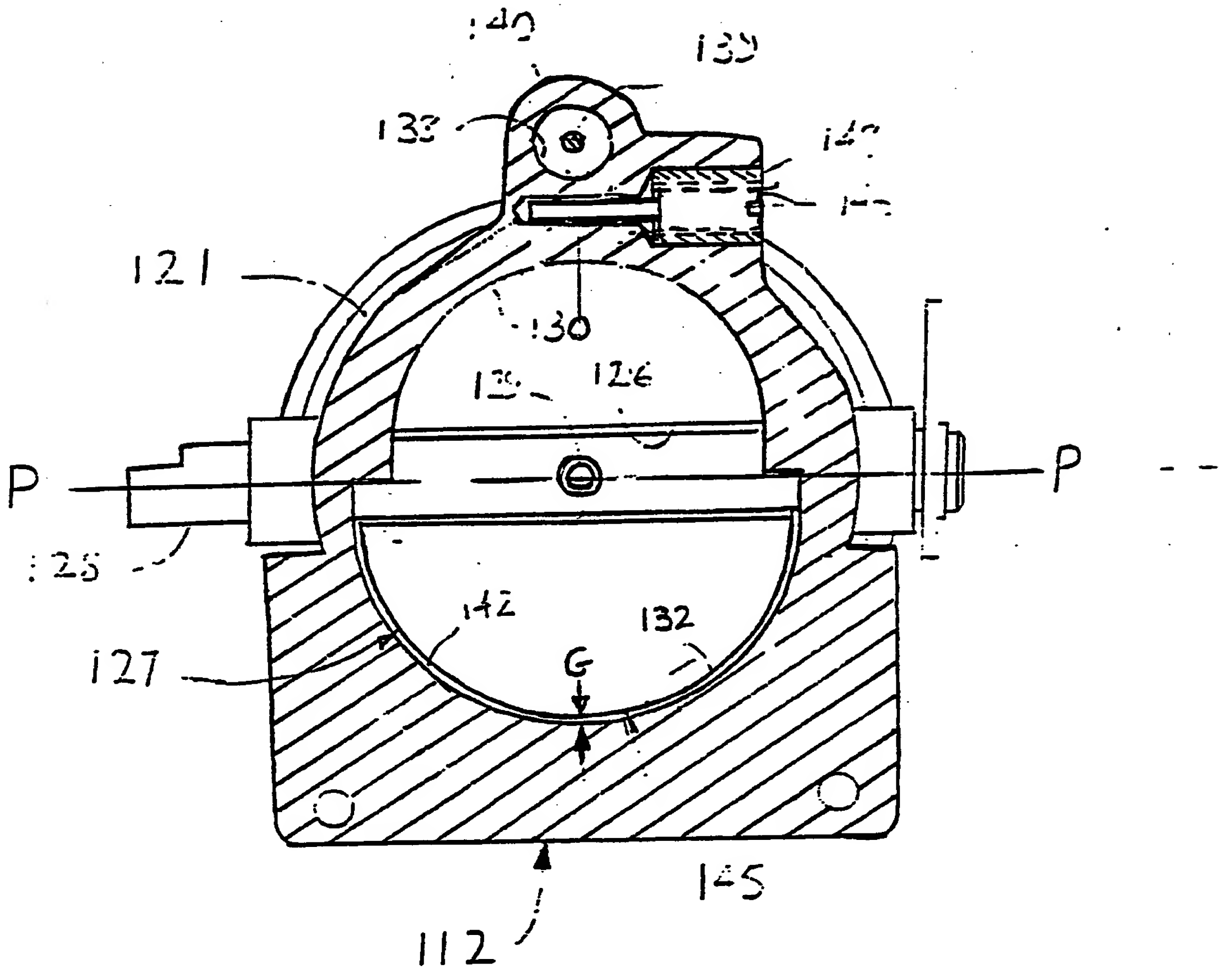


Figure 9

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AN AIR FLOW CONTROL DEVICE FOR THE INDUCTION SYSTEM OF AN INTERNAL COMBUSTION ENGINE

This invention relates to internal combustion engines and in particular to an air flow control device therefor.

It is known to provide an air flow control device often known as a throttle body for an induction system of an internal combustion engine having a body with a through bore in which is rotatably mounted a disc type valve element. The body of such a prior art air flow control device is normally made from a light alloy material and has a very accurately machined bore and an accurately manufactured disc valve to ensure that when the disc valve is in its closed position obscuring the bore the leakage of air past the disc valve is accurately controlled.

It is a problem with such prior art air flow control devices that because of the accuracy required they are expensive to manufacture.

According to the invention there is provided an air flow control device for the induction system of an internal combustion engine, the device comprising a body defining a longitudinal passageway extending between first and second ends of the body and a valve element moveably supported within said passageway by the body to provide a means of varying the cross-sectional area of the passageway wherein said body is made from a plastic material.

Preferably, the valve element is a flat plate valve element rotatable about an axis of rotation arranged substantially normal to the longitudinal axis of the passageway.

Advantageously, the passageway has a first step therein defining a first sealing surface facing the first end of the body.

Advantageously, in addition to said first sealing surface there is a second step defining a second sealing surface facing the second of the body.

Preferably, when the valve element is in its closed positon obscuring the passageway a portion of the side face of the valve element facing the second end of the body is in sealing abutment with the first sealing surface.

Preferably, when the valve element is in its closed position obscuring the passageway a portion of the side face of the valve element facing the first end of the body is in abutment with the second sealing surface.

Advantageously, the first and second sealing surfaces may be substantially parallel to a plane arranged normal to the longitudinal axis of the passageway.

This has the advantage that minor variations in the transverse dimension of the passageway do not adversely effect the ability of the valve element to co-operate effectively with the first and second sealing surfaces.

The flat plate valve element may be a part oval or part circular disc valve element attached to a shaft rotatably supported by the body.

The first sealing surface may be in the form of a first arcuate face.

The second sealing surface may be in the form of a second arcuate face.

Preferably, the distance from the or each arcuate face to the respective end of the body to which it is facing is equal to or greater than the corresponding distance from that respective end to the axis of rotation of the valve element.

Advantageously, the disc valve element is a plastic disc valve element part of the outer peripheral side face of which forms an integral lip seal for co-operation with the first arcuate face when the valve element is in the closed position.

This has the advantage that the valve element is cheap to manufacture.

Alternatively, the disc valve element may be a plastic disc valve element part of the outer peripheral side face of which has a resilient seal member of a different material attached thereto for cooperation with the first arcuate face when the valve element is in the closed position.

Advantageously, the resilient seal is attached to the valve element by being co-moulded therewith.

Part of the periphery of the disc valve element may have a part spherical radius formed thereon for co-operation with the wall of the passageway opposite the first sealing surface.

This has the advantage that the change in cross-sectional area of the passageway as the valve element is initially moved away from the closed position is more progressive.

Alternatively, part of the outer peripheral side face of the disc valve element may have a stop means formed integrally therewith for abutment against the second arcuate face when the valve element is in the closed position.

This has the advantage that an external or auxiliary stop is not required thereby reducing the cost of manufacture and assembly.

The first or second arcuate faces may have a resilient arcuate seal attached thereto preferably by co-moulding in situ with the body.

A bypass passage may be formed as an integral part of the body, the bypass passage entending from a position in the passageway towards the first end of the body with respect to the valve element to a position in the passageway towards the second end of the body with respect to the valve element.

Preferably, part of the bypass passage is defined by a housing for a bypass flow control valve.

Advantageously, the housing is moulded as an integral part of the body of the air flow control device.

The invention will now be described by way of example with reference to the accompanying drawing of which:-

Figure 1: is a schematic drawing of an internal combustion engine and an induction system therefor;

Figure 2: is a plan view of an air flow control device according to a first embodiment of the invention;

Figure 3: is a side view in the direction of arrow 'A' on figure 2;

Figure 4: is a cross-section on the line X-X on figure 2;

Figure 5: is an end view in the direction of arrow 'B' on figure 4;

Figure 6: is an enlarged view of part of the cross-section shown in figure 4 as indicated by the circle 'Y';

Figure 7: is an enlarged view of part of the cross-section of figure 4 as indicated by the circle 'Z';

Figure 8: is a cross-section through an air flow control device according to a second embodiment of the invention;

Figure 9: is a staggered cross-section on the line Y-Y on figure 8.

With particular reference to Figure 1 there is shown an engine 14 having an inlet manifold 13 connected thereto. The inlet manifold 13 is provided to connect the inlet ports (not shown) of the engine 14 to an air flow control device 12.

The air flow control device 12 includes a moveable disc valve element 27 to vary the volume of air drawn in through an air cleaner 11 by the engine.

The valve element 27 is moveable by means of a cable 24 connected to a driver operable pedal 25.

With particular reference to figures 2 to 7 there is shown an air control device according to a first embodiment of the invention the air flow control device 12 having an injection moulded rigid plastic body 21 defining a passageway 30 in which is rotatably supported the disc valve element 27.

The passageway 30 extends from the first end 22 of the body to a second end 23 of the body 21 along a longitudinal axis L-L.

The disc valve element 27 is attached to a shaft 28 by means of a screw 29, the shaft 28 being located by a groove 26 in the valve element 27.

The disc valve element 27 is rotatable about an axis of rotation R-R which is substantially normal to the longitudinal axis L-L of the passageway 30 and intersects the longitudinal axis L-L of the passageway 30 at a position between said first and second ends 22 and 23 of the body 21.

The passageway 30 is defined by a first bore 31 having tapered and parallel sections extending from the first end 22 and a second bore 32 extending from the second end 23, the interaction of the first and second bores 31 and 32 at the position of juncture forms two opposing steps which form first and second sealing surfaces 33 and 34. The first sealing surface faces towards the first end 22 of the body 21 and is in the form of a first arcuate face 33. The second sealing surface faces towards the second end 23 of the body 21 and is in the form of a second arcuate face 34.

The distance of the first arcuate face 33 from the first end 22 as indicated by the reference numerals F1 is greater than the corresponding distance from the first end 22 to the axis of rotation R-R of the valve element 27 as indicated by the numerals V1.

Similarly, the distance of the second arcuate face 34 from the second end 23 is greater than the corresponding distance from the second end 23 to the axis of rotation R-R of the valve el ment 27.

The disc valve element 27 is injection moulded from a resilient plastic material and has a lip seal 35 formed as a integral part thereof around part of its outer periphery for cooperation with the first arcuate face 33.

The portion of outer periphery of the disc valve element 27 opposite to the position where it forms a lip seal 35 is thickened to form a stop 36 for cooperation with the second arcuate face 34.

The abutment of the stop 36 with the second arcuate face 34 prevents over-rotation of the disc valve element 27 and consequential damage to the lip seal 35 without the need for an external stop mechanism.

The first and second arcuate faces 33 and 34 are parallel to but offset substantially the same distance from a plane along the axis of rotation R-R of the disc valve element 27 arranged normal to the longitudinal axis L-L of the passageway 30.

Transverse changes of the dimension of the passageway 30 which occur due to thermal expansion or contraction of the body 21 are accommodated without effecting the effectiveness of the seal formed between th lip seal 35 and the first

arcuate surface 33 or the accuracy of abutment of the stop 36 with the second arcuate sealing surface 34.

For example, expansion of the passageway 30 will merely result in a movement of the position of contact between the lip seal 35 and the first arcuate surface 33 or the stop 36 and the second arcuate surface 34.

Similarly, positioning the first and second arcuate faces 33 and 34 parallel to but offset from said plane along the axis of rotation R-R of the disc valve element 27 arranged normal to the longitudinal axis L-L of the passageway 30 reduces the need for the valve element 27 and the passageway 30 to be produced to such a high degree of accuracy.

A bypass passage 38 connects the first bore 31 with the second bore 32 to provide a passageway around the disc valve element 27 when the disc valve element 27 is in its closed position obscuring the passageway 30.

An idle speed control valve 39 is positioned in a housing 40 defining part of the bypass passage 38, the idle speed control valve 39 being moveable by a stepper motor 41 to control the amount of air that is permitted to bypass the disc valve element 27 through the bypass passage 38.

Operation of the air flow device as part of the induction system for an internal combustion engine is as follows.

When the engine 14 is idling the disc valve element 27 is in the closed position shown in figures 2 to 7 thereby providing the maximum restriction to the flow of air from the air cleaner 11 connected to the first end 22 of the body 21 through the passageway 30 to the inlet manifold 13 connected to the second end 23 of the body 21 and hence into the engine 14.

The actual flowrate of air through the passageway 30 will depend upon the leakage past the disc valve element 27 and the flow of air through the bypass passage 38.

The bypass valve 39 controls the flowrate of air through the bypass passage 38 and is moved by the stepper motor 41 to a position apprpriate to the running conditions of the engine as sensed by an engine control unit (not shown).

The engine control unit receives information from various sensors located on the engine and the exhaust system of the engine which is used to provide a control signal to the stepper motor 41 to provide smooth idling with low emmissions.

Movement of the pedal 25 causes the disc valve to be opened and closed through approximately 90 degrees.

In the open position the disc valve element 27 lies approximately parallel to the longitudinal axis L-L and has very little restricting effect on the flow of air through the passageway 30 and is often referred to as the full throttle or wide open position.

With particular reference to figures 8 and 9 there is shown an air control device according to a second embodiment of the invention the air flow control device 112 having an injection moulded rigid plastic body 121 defining a passageway 130 in which is rotatably supported a disc valve element 127.

The passageway 130 extends from a first end 122 of the body to a second end 123 of the body 121 along a longitudinal axis M-M.

The disc valve element 127 is attached to a shaft 128 by means of a screw 129 entending through a clearance hole 137 in the valve element 127.

The shaft 128 is located with clearance in a groove 126 in the valve element 127.

The disc valve element 127 is supported by the body 121 to allow rotation about an axis of rotation P-P which is substantially normal to the longitudinal axis M-M of the passageway 130.

The axis of rotation P-P intersecting the longitudinal axis M-M of the passageway 130 at a position between said first and second ends 122 and 123 of the body 121.

The passageway 130 is defined by a first bore 131 having tapered and parallel sections extending from the first end 122 and a second bore 132 extending from the second end 123.

The interaction of the first and second bores 131 and 132 at the position of juncture forms a step defining a first sealing surfaces 133.

The first sealing surface faces towards the first end 122 of the body 121 and is in the form of a first arcuate face 133.

A second sealing surface 134 is defined by the part cylindrical wall 142 of the part of the passageway 130 which is common to the first and second bores 131 and 132.

The disc valve element 127 is injection moulded from a resilient plastic material and has a lip 135 formed as a integral part thereof around part of its outer periphery for cooperation with a seal 143 attached by co-moulding to the first arcuate face 133.

A portion 145 of outer periphery of the disc valve element 127 opposite to the position where it is in the form of a lip 135 is thickened and is of a spherical radius form.

The disc valve element 127 can be transversely adjusted to alter the gap 'G' between the portion 145 of the valve element 127 furthest from the axis P-P and the wall 142 by loosening the screw 129.

This allows for the gap 'G' to be accurately set without the need for great accuracy in the relative dimensions of the valve element 127 and bore 132.

The size of the gap 'G' will effect the leakage of air past the valve element 127 when the valve element 127 is in the closed position obscuring the passageway 130 as shown in figures 8 and 9.

The part spherical form of the portion 145 is complimentary to the adjacent wall 142 and therefore upon initial rotation of the valve element 127 away from the closed position the gap 'G' remains substantially constant and the only change in leakage past the valve element 127 occurs through the increasing aperture between the lip 135 and the seal 143.

The first arcuate face 133 is parallel to but offset from a plane along the axis of rotation P-P of the disc valve element 127 arranged normal to the longitudinal axis M-M of the passageway 130.

The distance of the first arcuate face 133 from the first end 122 as indicated by the reference numerals L1 is greater than the corresponding distance from the first end 122 to the axis of rotation P-P of the valve element 127 as indicated by the numerals S1 this permits at least 90 degrees of valve element 127 rotation from the closed position to the fully open position when the valve element 127 is positioned substantially parallel to the axis M-M.

A bypass passage 138 connects the first bore 131 with the second bore 132 to provide a controllable leakage path around the disc valve element 127 when the disc valve element 127 is in its closed position obscuring the passageway 130.

An idle speed control valve 139 is positioned in an integrally moulded housing 140 defining part of the bypass passage 138.

The idle speed control valve 139 is moveable by a stepper motor 141 to control the amount of air that is permitted to bypass the disc valve element 127 through the bypass passage 138.

A trim screw 146 is provided to regulate the flow of air through a trickle passage 147 joining the inlet to and outlet from the bypass passage 138.

The trim screw 146 is threadingly engaged with a metal bush 148 moulded in situ with the body 121.

The trim screw 146 allows the volume of air passing through the air flow control device 112 to be accurately set when the disc valve element 127 is in the closed position and the bypass valve 139 is in the closed position.

Although the invention has been described with reference to two preferred embodiments it is not to be construed as limited to these embodiments. For example the cable linkage could be replaced by a mechanical linkage or drive by wire type system and the combination of a lip seal and integral stop could be replaced by two lip seals and an external stop.

Similarly, a lip seal could be formed as an integral part of the disc for use in replacement for the moulded in-situ seal of the second embodiment.

CLAIMS

1. An air flow control device for the induction system of an internal combustion engine the device comprising a body defining a longitudinal passageway extending between first and second ends of the body and a valve element moveably supported within said passageway by the body to provide a means of varying the cross-sectional area of the passageway wherein said body is made from a plastic material.

2. A device as claimed in Claim 1 in which the valve element is a flat plate valve element rotatable about an axis of rotation arranged substantially normal to the longitudinal axis of the passageway.

3. A device as claimed in Claim 2 in which the passageway has a first step therein defining a first sealing surface facing the first end of the body.

4. A device as claimed in Claim 3 in which in addition to said first sealing surface there is a second step defining a second sealing surface facing the second end of the body.

5. A device as claimed in Claim 3 or in Claim 4 in which when the valve element is in its closed position obscuring the passageway, a portion of a side face of the valve element facing the second end of the body is in sealing abutment with the first sealing surface.

6. A device as claimed in Claim 4 in which when the valve element is in its closed position obscuring the passageway, a portion of a side face of the valve element facing the first end of the body is in abutment with the second sealing surface.

7. A device as claimed in any of Claims 4 to 6 in which the first and second sealing surfaces are substantially parallel to a plane arranged normal to the longitudinal axis of the passageway.

8. A device as claimed in any of Claims 4 to 7 in which the flat plate valve element is a part oval or part circular disc valve element attached to a shaft rotatably supported by the body.

9. A device as claimed in any of Claims 3 to 8 in which the first sealing surface is in the form of a first arcuate face.

10. A device as claimed in any of Claims 4 to 9 in which the second sealing surface is in the form of a second arcuate face.

11. A device as claimed in Claim 9 or in Claim 10 in which the distance from the or each arcuate face to the respective end of the body to which it is facing is equal to or greater than the corresponding distance from that respective end to the axis of rotation of the valve element.

12. A device as claimed in Claim 11 in which the difference in distance is less than 10mm.

13. A device as claimed in Claim 9 or in Claim 10 in which the disc valve element is a plastic disc valve element part of the outer peripheral side face of which forms an integral lip seal for cooperation with the first arcuate face when the valve element is in the closed position.

14. A device as claimed in Claim 13 when dependent upon Claim 9 in which part of the periphery of the disc valve element has a part spherical radius formed thereon.

15. A device as claimed in Claim 13 when dependent upon Claim 10 in which part of the outer peripheral side face of the disc valve element has a stop means formed integrally therewith for abutment against the second arcuate face when the valve element is in the closed position.

16. A device as claimed in Claim 9 or in Claim 10 in which the disc valve element is a plastic disc valve element part of the outer peripheral side face of which has a resilient seal member attached thereto for co-operation with the first arcuate face when the valve element is in the closed position.

17. A device as claimed in Claim 16 when dependent upon Claim 9 in which part of the outer periphery of the disc valve element has a part spherical radius formed thereon.

18. A device as claimed in Claim 16 when dependent upon Claim 10 in which part of the outer peripheral side face of the valve element has a stop means formed integrally therewith for abutment against the second arcuate face when the valve element is in the closed position.

19. A device as claimed in Claim 17 or in Claim 18 in which the resilient seal is attached to the valve element by being co-moulded therewith.

20. A device as claimed in Claim 9 or in Claim 10 in which the first arcuate face has a resilient arcuate seal attached thereto.

21. A device as claimed in Claim 20 in which the arcuate seal is attached by co-moulding insitu with the body.

22. A device as claimed in any of claims 1 to 21 in which the device includes a bypass passage extending from a position in the passageway towards the first end of the body with respect to the valve element to a position in the passageway towards the second end of the body with respect to the valve element.

23. A device as claimed in claim 22 in which part of said bypass passage is defined by a housing for a bypass flow control valve.

24. A device as claimed in Claim 23 in which the housing is moulded as an integral part of the body of the air flow control device.

25. A device substantially as described herein with reference to the accompanying drawing.

26. An induction system for an internal combustion engine including an air flow control device as claimed in any of Claims 1 to 23.

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